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THE RESOLUTIONS CONCERNING THE COAST-SURVEY.

THE following are the resolutions referred to in our leading article, and unanimously passed by the association at its general session of Aug. 28: —

WHEREAS, The attention of this association has been called to articles in the public press, purporting to give — and presumably by authority — an official report of a commission appointed by the Treasury department to investigate the condition of the U. S. coast-survey office, in which report the value of a certain scientific work is designated as 'meagre;'

AND WHEREAS, This association desires to express a hope that the decision, as to the utility of such scientific work, may be referred to scientific men, —

Resolved, That the American association for the advancement of science is in earnest sympathy with the government in its every intent to secure the greatest possible efficiency of the public service.

Resolved, That the value of the scientific work performed in the various departments of the government can be best judged by scientific men.

Resolved, That this association desires to express its earnest approval of the extent and high character of the work performed by the U. S. coast-survey, — especially as illustrated by the gravity determinations now in progress, — and to express the hope that such valuable work may not be interrupted.

Resolved, That this association expresses, also, the hope that the government will not allow any technical rule to be established that shall necessarily confine its scientific work to its own employees.

Resolved, That in the opinion of the American association for the advancement of science, the head of the coast-survey should be appointed by the president, by and with the advice and consent of the senate, should have the highest possible standing among scientific men, and should command their entire confidence.

Resolved, That copies of these resolutions shall be prepared by the general secretary, and certified by the president of the association and by the permanent secretary, and shall be forwarded to the president of the United States, and the secretary of the treasury, and given to the press.

PROCEEDINGS OF THE SECTION OF ASTRONOMY AND MATHEMATICS.

PERHAPS the small number of members in attendance, especially in section A, and the consequent dearth of papers, may have been, in the minds of the sectional committee, a sufficient excuse for the appearance of the first two numbers upon the programme; but it would certainly be far better to reduce the number of meetings of the section in such a case, and thus grant its members more opportunity for hearing valuable papers in others, than to occupy its time, and detract from its dignity, by the serious consideration of such material as that first offered to the section of mathematics and astronomy. The first of these choice contributions was by Mr. Thomas Bassnett of Jacksonville, Fla., entitled 'Intimate connection between gravitation and the solar parallax.' The only important truth stated in the paper, the one set forth as a new and important discovery, and the principal feature of the matter, was simply another way of stating Kepler's third law, and offers no method whatever of determining the solar parallax. The rest of the paper was principally nonsense. The next paper by Mr. S. S. Haight upon 'Rapidity of calculation,' etc., was only a *résumé* of some short cuts, principally in cross-multiplication, which are given in many elementary arithmetics, and are familiar, or would suggest themselves, to any one having occasion to make any extended computations in that manner; while the speaker's remarks about the use of logarithms only served to show his ignorance of the whole matter.

The section then settled down to the consideration of serious business in listening to a paper by Prof. H. A. Newton of Yale college, upon 'The effect of small bodies passing near a planet upon the planet's velocity.' The former researches of Professor Newton, upon meteors, are recognized among astronomers as our principal source of knowledge about the character, distribution, and motion of these minute bodies with which the solar system is filled, especially those which strike our atmosphere, and are burned up as meteors. The possible effect of these upon the rotation of the earth, and the revolution of the earth and moon in their orbits, has been subjected to elaborate investigation at the hands of several mathematical astronomers. The recent publications of Mr. Denning of Bristol, Eng., claiming the fixity of long-continuing radiant points of meteor streams, have raised the question of the existence of broad streams of meteoroids moving swiftly through stellar space outside of solar attraction; and any new investigation bearing upon any of these points is more than usually timely. In this paper Professor Newton has discussed the effect upon the earth's motion of those bodies which do not pass near enough to the earth to be drawn into its atmosphere, but still near enough to be drawn out of their course, and swung for a time in hyperbolic orbits round it. He began by saying that the results of the investigation might perhaps be considered negative as far as measurable quantities in the solar system are concerned, but that they had a mathematical interest, and might possibly have a bearing upon somewhat similar questions in molecular physics, like the kinetic theory of gases. The mathematician and astronomer must be referred to the paper itself, but the results of popular interest may be briefly summarized as follows: Considering, first, the case of a cylindrical stream of small bodies evenly distributed, and all moving in the same direction with a common velocity past the earth supposed to be in the axis of the cylinder, it is shown that they will communicate to the earth in each unit of time a velocity along the axis: 1°, that is proportional to the density of the group; 2°, that decreases as the

velocity increases, nearly inversely as the square of the velocity; 3°, that increases as the logarithm of the radius of the cylinder, the radius being measured by a unit differing from the earth's radius by a small quantity, which is a function of the velocity. Second, in the case of a widely extended group of small bodies evenly distributed in space, and having speeds all equal, but directed towards points evenly distributed over the celestial sphere with the earth moving in a right line through them, it is shown that, for those which do not strike the earth, but only affect it by their attraction, the effect will be an exceedingly minute acceleration of the earth's motion, if the latter *is less than that of the bodies*, even though the group is infinite in extent. If the earth's velocity *is greater than that of the bodies*, their total effect will consist of two parts; a very minute retardation of the earth's motion depending in amount upon the absolute velocity of the bodies, and another retardation depending upon the assumed extent of the group. In conclusion, the effect of bodies *striking* the earth or moon is manifold greater than that of those only *passing near;* and since it has before been shown that any admissible magnitude of meteoroids would make the effect upon the moon's mean motion of those which strike it only a minute fraction of the observed acceleration, still less can any action of those passing near the moon have any appreciable effect. The hour of adjournment prevented any discussion of this interesting paper.

The first paper of Friday's session was by Prof. Wm. Harkness of the U. S. naval observatory upon the flexure of transit instruments. The time-observations of the different transit-of-Venus parties in 1874 and 1882, — and the latitude observations as well, — were made with transit instruments of the 'bent' or 'broken' pattern; i.e., a totally reflecting prism is placed in the tube of the axis, and thus one-half of the axis itself forms a part of the telescope tube, the eye-piece and micrometer being at one end of the axis. This form, while allowing great convenience and rapidity of manipulation, introduces new difficulties through the flexure in the support of the central prism; and the discussion of these has led Professor Harkness to make a thorough investigation of the flexure of transit instruments from the most general standpoint. The details are of too technical a character for popular presentation; and we can only state the general nature of the subject, and give a brief summary of the points brought out. Astronomers, in the most exact measurements possible with their instruments, have always been obliged to consider even the most rigid of them as elastic, and as bending differently under the force of gravity as they are swung into different positions. But if they are entirely symmetrical in construction with reference to a vertical plane, it is generally assumed that the entire flexure takes place parallel to that plane; and hence that the line of collimation determined by reversal upon a collimator, or by a pair of opposite collimators, is at right angles to the axis when corrected for inequality and irregularity of pivots. But the special point of Professor Harkness's paper was, that, on account of unequal elasticity in the different parts of any instrument, this condition could only be certainly fulfilled when the direction of gravity through the instrument was not changed by the operation. This could only be done by reversal either upon a *zenith-collimator* or *over the nadir*, and in these two positions only could the line of collimation be considered as rigorously at right angles to the axis. The other conclusions were, that for the particular zenith distance at which a line of collimation is determined, that line possesses the essential properties of a line at right-angles to the axis, but for no other zenith distance; and that flexure at right angles to the meridian consists of two parts, the larger of which is measurable by a pair of collimators, but the smaller is only determinable by star-transits. For field instruments this method would be feasible; but in the case of larger meridian instruments, which are supposed to correct the positions of the stars, this would hardly be allowable in fundamental work. Prof. H. M. Paul of the naval observatory remarked that the results of the paper emphasized anew the necessity, in the great bulk of meridian observations, of work in zones, the positions of the zero-stars in these zones depending upon some good fundamental system like that of Auwers; and also, in the formation of such a system of fundamental positions, the advantage of giving greater weight to the work of different observatories upon the stars which culminated near their zeniths, provided they could determine their collimation by reversal upon a zenith collimator.

The next paper was by Prof. G. W. Hough, director of the Dearborn observatory at Chicago, describing some improvements recently introduced in the printing-chronograph, first designed and brought into use by himself at the Dudley observatory in 1871. This instrument is designed to print upon a fillet of paper the minutes, seconds, and hundredths of seconds, indicated by the clock which controls it, at any instant when an observing-key is closed by the observer's finger. The impression is made from the surface of three continuously running type-wheels, the swiftest of which revolves once per second, and is controlled each second by the standard clock. The recent improvements consist in engraved type on the face of the wheels in place of the rubber ones used at first, which required too frequent renewal; and of the substitution of a direct blow by an electro-magnet upon the type-wheel fillet, thus making the apparatus much more light and compact than the old form. For this Professor Hough uses three cells of a storage battery, each of about two volts electromotive force, and from 0.3 to 0.4 of an ohm resistance, thus furnishing a strong current for the printing-magnet. The cells are kept permanently coupled to the chronograph, and are charged by eight small gravity cells having a resistance of 7 to 10 ohms each. He claimed that it was perfectly reliable, and eminently a labor-saving machine; and described its use in making transit observations as a luxury that no one would do without after trying it, the mean of the seconds and hundredths being taken directly

on the fillet without transferrence to books. In response to inquiry, he stated that the difficulty in getting a circuit through a clock-pendulum and globule of mercury, which would be absolutely sure to close every second, might be entirely overcome by having the mercury pure and making sure of good connections; that the difference between commercial and pure mercury was a very marked one in this case. Mr. J. A. Brashear of Pittsburgh called attention to the growing importance of chronographic records in all employment of men and machinery, and described a very perfect system in use in some manufactories. Professor Newton referred to the very convenient system of the Repsolds, for printing rapidly the settings of micrometer-screws, as well illustrated upon the new Yale college heliometer in charge of Dr. Elkin. Prof. C. S. Peirce of the coast survey called attention to the great gain this would be in recording the readings of micrometer screws in the comparison of standards of length where rapidity was highly desirable, and especially the avoidance of the necessity of removing the eye continually from the eye-piece to read off the head. Professor Paul alluded to his hope of soon applying Repsold's apparatus where rapidity was of the first importance; viz., in recording the settings of the position-circle of the Nicol-prism in Professor Pickering's method of observing the eclipses of Jupiter's satellites, where as many settings as possible are wanted while the satellite is entering or leaving the shadow; and he said he hoped, with a chronograph-key in one hand, and managing the Nicol and its printer with the other, to be able to secure the record of the times and settings of the Nicol-circle every two or three seconds, working entirely in the dark, and keeping it up as long as desired.

The next paper, by Prof. J. Burkitt Webb, described a method of using polar coördinates, by transferring the origin from the centre to the end of the unit-radius, — thus substituting $(r-1)$ for r,— and then using the length of the arc and the distance out from its end upon the radius vector, as x and y are used in rectangular coördinates. He found this a very convenient transformation in the application of polar coördinates to the discussion of Amsler's planimeter; and pointing out that by substituting infinity for unit-radius in the equations thus transformed, they were reduced to those of rectangular coördinates, he thought this transformation of polar coördinates might be found generally useful.

The only paper on Monday was a presentation by Mr. C. H. Rockwell of Tarrytown, N.Y., of some results of his observations for time and latitude with the almucantar, an instrument devised by Mr. Chandler of the Harvard-college observatory a year or two ago, which promises at least to furnish an entirely new and radically different method of attacking the question of absolute positions of the stars, and very probably far to surpass all others in accuracy, on account of its freedom from systematic errors. The results thus far published by Mr. Chandler seem fully to confirm all that was expected of the instrument; and it is probably not too much to say, that it is the most important addition of the present century to the instruments and methods used in the determination of absolute star-positions. The sources of systematic error would seem to be almost wholly reduced to those of varying personal equation in the observation of transits at all speeds, and at all inclinations and directions over horizontal wires, and to possible systematic difference in atmospheric refraction in different azimuths. Mr. Rockwell exhibited some results, simply copied from his observing-books, illustrating the methods of reduction for time and latitude observations, and showing the degree of accuracy that can be attained by the instrument in both these directions. They served to show that the instrument when duplicated will give equally good results with the one first constructed; and their consideration gave rise to a very interesting discussion, participated in by many members, as to the character of work the instrument might be expected to do, in the course of which Mr. Rockwell answered, in a very entertaining way, many questions, put by various members, as to the details of observing and reducing, which were not before clearly understood on account of the novelty of the work. One of the most important problems which the instrument is specially adapted to investigate, and one which we hope Mr. Chandler will soon find time to undertake, is the determination of the declination of fundamental stars south of the equator, tying them to northern stars at corresponding zenith distances below the pole. This would seem to be by far the best, perhaps the only, method of connecting these together in a way that shall be free from systematic error.

PROCEEDINGS OF THE SECTION OF PHYSICS.

THE first paper read before the section of physics was by Prof. S. P. Langley, on the spectra of some sources of invisible radiations, and on the recognition of hitherto unmeasured wave-lengths. The measurement of infra red wave-lengths has heretofore been confined to those found within the range of the solar-heat spectrum. It is of interest to know whether there are other wave-lengths than those found in the sun's heat, so that we may perhaps explain how it is that the surface heat of one planet is maintained in spite of the ready radiations of extreme solar heat through the atmosphere. Our knowledge of wave-lengths is comparatively recent, as Fraunhofer gave the first accurate measures in 1823. His range of values was from .00036 to .00075 of a millimetre. The use of the florescent eye-piece and photography has extended the range. The extreme range of the normal eye is from about .00036 to .00081 of a millimetre, or a little over one octave. It has been known since the time of the first Herschel, that heat radiations existed below the range of vision; but it was supposed that glass absorbed this dark heat. In 1881 Professor Langley found that common glass was diathermanous to all the dark rays which come to us